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ABSTRACT

The primary objective of this study was to determine the existence of a relationship between free-recall learning and breadth of categorization, an independent measure of conceptual organization. The relationship between breadth of categorization and more conventional measures of organization was also investigated. Two free-recall tasks (categorized and noncategorized) and two measures of breadth of categorization (band-width and equivalence range) were administered to 144 fifth grade subjects. The free-recall tasks consisted of lists of 30 high frequency words. One list was composed of six conceptual categories; the other list consisted of 30 unrelated words randomly selected from the 1,000 most frequent words in the English language. The Category Width Test was administered two days after the learning of the free-recall lists. Relationships were found between the average size of the groupings and the number of objects left ungrouped on the equivalence range task and the noncategorized free-recall task, whereas only the number of objects left ungrouped on the equivalence range task was found to be related to categorized free-recall. Band-width was related to observed-expected repetitions and the adjusted ratio of clustering. (WR)

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Organization, Breadth of Categorization and Free-Recall Learning in Children[1]

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The primary objective of the present study was to ascertain the existence of a relationship between free-recall learning and breadth of categorization, an independent measure of conceptual organization. The relationship between breadth of categorization and more conventional measures of organization [observed - expected repetitions (O-E) and the Adjusted Ratio of Clustering (ARC)] was also investigated. Two free-recall tasks (categorized and noncategorized) and two measures of breadth of categorization (band-width and equivalence range) were administered to the 144 fifth-grade subjects. Relationships were found between the average size of the groupings and the number of objects left ungrouped on the equivalence range task and the noncategorized free-recall task, whereas only the number of objects left ungrouped on the equivalence range task was found to be related to categorized free-recall. Band-width was found to be related to the O-E and ARC clustering measures. A post hoc analysis revealed that order of presentation (categorized or noncategorized list first) influenced free-recall performance on the categorized list only. It is suggested that this "order effect" be the subject of future experimentation.

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Organization, Breadth of Categorization and Free-Recall Learning in Children[1]

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The study of organizational processes in children has been approached from several rather different perspectives, and unfortunately, there have been very few attempts to integrate, or even compare, the data produced by the various approaches. For example, the role of organization in free-recall learning has been the subject of considerable experimentation and theorizing within the context of the free-recall task itself (e.g., Shuell, 1969; Tulving & Donaldson, 1972), but there have been few attempts to relate free-recall performance to measures of organization which are independent of the learning task (Shuell, 1969).

One approach to the study of organizational processes in which the measures of organization are independent of any learning task is the research concerned with breadth of categorization as measured by band-width and equivalence range (e.g., Wallach & Kogan, 1966). This research has been concerned with investigating the extent to which individuals normally group objects into conceptual categories, the size of these self-created groupings, and the range a person tends to use for generalizing within a given category while still conceiving it as the same concept. These types of processes appear to be rather similar to the ones operating in free-recall learning (Shuell, 1969; Tulving, 1968).

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In free-recall learning individuals tend to group items into categories in learning both categorized and noncategorized lists, and the number and size of the categories is positively related to free-recall performance. Thus, the same basic processes may be operating in both situations, and if this is the case, breadth of categorization may provide us with an appropriate method and context for measuring organization independent of the free-recall task. The availability of such independent measures would provide us with a stronger methodology for studying the relationship between organization and learning. In addition, comparison of data from the two different approaches to the study of organizational processes may provide us with useful information on the basic processes involved and allow us to integrate some of the data available in the two areas.

While it has been suggested that performance on the equivalence range task may be related to performance in free-recall learning (Gardner & Schoen, 1962), we are not aware of any studies that have actually investigated the relationship among the various measures involved in breadth of categorization and free-recall learning. Therefore, the purpose of the present study is to determine the degree to which these independent measures of organization are related to one another and to children's performance on both categorized and noncategorized free-recall tasks.

Method

Subjects

One hundred forty-four fifth-grade children from the same suburban elementary school took part in the study. The 71 male

and 73 female subjects (Ss) were 10 and 11 years old. The Ss were from two different teams within the school. Each team consisted of two heterogeneous classes. Testing for the free-recall and band-width tasks was done in the students' regular classroom, while the equivalence range task was administered to each S individually in a private room.

Materials and Procedures

Free-recall tasks: Two free-recall tasks were presented for a single trial each to classroom-size groups. Each list consisted of 30 high-frequency words. One list was composed of six conceptual categories (5 words to a category) chosen from the Battig and Montague (1969) category norms. The six categories used were animals, body parts, colors, fruits, furniture, and musical instruments. Category members were randomly distributed throughout the list. The other list consisted of 30 unrelated words randomly selected from the 1000 most frequent words in the English language (Thorndike & Lorge, 1944). As a control procedure, half of the Ss received the categorized list first, whereas the other half received the noncategorized list first. Each word was presented at a 2-second rate by an automatic slide projector. After all 30 words had appeared, a special slide (*****) signaled the end of the list. The Ss had been instructed to write down, in the order in which they thought of them, as many words from the list as they could remember when this special slide appeared. They had been told that they should write down even those words they were unsure of and that spelling would not be counted. Two minutes were allowed for recall. After completion of the first test, the recall sheets

were collected, fresh sheets of paper were distributed, instructions were reviewed, and the second list (either noncategorized or categorized depending on the group) was administered. The number of words correctly recalled from each list were used as the measures of free-recall learning. Performance on the categorized list was also indexed by the number of categories represented in the words recalled and the average number of words recalled per category (words/category). In addition, the observed minus the expected number of repetitions (O - E) (Bousfield & Bousfield, 1966) and the Adjusted Ratio of Clustering (ARC) (Roenker, Thompson, & Brown, 1971) were calculated for the categorized list and used as measures representative of the two major types (deviation and ratio) of scores for measuring clustering in free-recall.

Band-width test: The Wallach and Caron (1959) version for children of the Pettigrew (1958) Category Width Test was administered in the children's regular classrooms two days after the learning of the free-recall lists. This paper-and-pencil test contains twelve statements. Each statement represents a conceptual category for which the child establishes a range by selecting an upper and lower boundary from four alternate choices. These choices are keyed 1, 2, 3, or 4, and respectively represent responses that vary from the least to the most discrepant from the central tendency provided for each item. These 24 items were summed to produce a total score; a large score reflects a preference for broad band-widths, a small score reflects a preference for narrow band-widths (Wallach & Kogan, 1966). The task was presented to the children as a guessing game. In order to pace the presentation and allow for poor readers, the entire test was read orally to the children as they read at their seats.

Equivalence range test: One week after the band-width test was administered, a version of the Clayton and Jackson (1961) Object Sorting Task as used by Wallach and Kogan (1966) was administered to each S individually. The materials for this task consisted of 50 black-on-white line drawings of common objects, each drawn on a separate 3 X 3 inch card. The pictures were set down on a table in 5 rows of 10 objects each; the same order being used for all the children. Each S was instructed to group the pictures together in any manner he chose, as long as the pictures in each group seemed to him to belong together for some reason. This task is considered to be a measure of equivalence range since the S is seeking equivalent attributes from a diverse assemblage of objects in order to create groupings, and therefore, he must ascertain the range of objects which he conceives as equivalent in this respect. The Ss were allowed to take as much time as they wished to complete the task, and a record was kept of how long each S worked on the Task. Five scores were calculated for each S: a conceptualization score (number of groups containing two or more objects), a compartmentalization score (number of groups containing a single item), the average number of items in each group (including groups of size one), the average range in group size (including groups of size one), and the time (in seconds) each S took to complete the object sort.

Results and Discussion

Means and standard deviations of the various measures: The means and standard deviations of the various measures used in the study are presented in Table 1 for males and females separately

and combined.[2] An inspection of Table 1 indicates that females

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Insert Table 1 about here

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recalled more words than males on both the noncategorized and categorized free-recall tasks, $F(1,142) = 16.57$, $p < .01$ and 6.05, $p < .02$, respectively, a rather typical finding. Females also recalled more categories on the categorized list (had more categories represented in the words recalled), $F(1,142) = 5.51$, $p < .05$. On the band-width test, males had a significantly broader band-width than females, $F(1,142) = 16.53$, $p < .01$. This finding is consistent with the results of previous research (Wallach & Caron, 1959; Wallach & Kogan, 1966). The only other differences that approached statistical significance was for the O-E measure of clustering, $F(1,142) = 3.62$, $p = .06$, on which the females scored higher than the males.

Intercorrelations among measures of organization: The intercorrelations among the various measures used in the study are presented in Table 2.[3] An inspection of the intercorrelations

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2. The separation between males and females is maintained for purposes of analysis since: 1) previous research has indicated that there is a tendency for these two sub-populations to differ in performance on tasks such as those used in the present study, and 2) a significant mean difference was found on the free-recall tasks between the male and female groups.

3. The values presented were calculated on the pooled, within sums of squares for the two sub-groups of males and females. This was considered to be the most appropriate procedure since significant mean differences were obtained between the two sub-groups. However, virtually the same conclusions are reached when the values are calculated on the two sub-groups separately or on the total population, i.e., total sums of squares for males and females combined.

Insert Table 2 about here

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among the various measures of organization reveals some rather interesting patterns of results. Performance on the band-width test does not correlate at all with any of the measures obtained from the equivalence range task. The lack of a correlation between band-width and the conceptualization and compartmentalization scores is consistent with previous research using children as Ss (Wallach & Kogan, 1966). However, there is a statistically significant correlation between band-width and the two measures of clustering from the free-recall test, although in both cases the value of this correlation is rather low (r = .19).

The lack of a correlation between the conceptualization and compartmentalization scores has been found before (Messick & Kogan, 1963). The relatively high correlations among the scores from the equivalence range task, with the exception of the correlation between conceptualization and compartmentalization, is not surprising as the number of objects was held constant. The time measure was positively related to conceptualization and negatively related to the range of group size on the equivalence range task. This indicates that the longer the S spent on the task, the more groups greater than one he formed and the narrower the range in size of all groupings including groups of one. The time measure did not correlate with any other indexes. The near zero correlations between the equivalence range scores and the two measures of clustering suggest that different organizational processes are assessed by the equivalence range task and the clustering measures.

The relatively high correlations between the two measures of clustering (r = .77) is typical. In general, the overall pattern of correlations among the various scores suggests that categorized free-recall, band-width, and equivalence range may be measuring different aspects of children's ability to organize.

Intercorrelations between the various measures of organization and free-recall performance: Further inspection of Table 2 indicates that the number of categories recalled on the categorized free-recall test and the number of words recalled per category are positively related to performance on both the categorized and noncategorized lists. The correlations between the first two variables and performance on the categorized list is an expected finding. However, the correlations between those variables and performance on a noncategorized list is a novel finding but may merely be a reflection of the correlation between the number of words recalled on the two free-recall lists (r = .45).

The positive correlation between the O-E measure of clustering and the number of words recalled from the categorized list is a typical finding, although the positive relationship between this measure of organization and performance on a noncategorized list has never been demonstrated before. Again, this may just be a reflection of the correlation between the number of words recalled on the two free-recall lists. The failure of the ARC measure to correlate with performance on either type of list is unexpected, and there does not appear to be any obvious explanation for this result.

The correlations between band-width and performance on the

two free-recall tasks are near zero. A prediction made by Gardner and Schoen (1962) that the conceptualization score on the equivalence range task would be positively related to recall on easily categorized material (e.g., a categorized free-recall test) was not supported since the conceptualization measure did not correlate with performance on either free-recall task. However, there was a significant negative correlation between the compartmentalization score and performance on the noncategorized and categorized list. In addition, there was a positive correlation between the average size of the groups formed on the equivalence range task and the number of words recalled on the noncategorized list. Average group size was not related to performance on the categorized list, and the range of category size on the equivalence range task was not related to performance on either of the free-recall tests.

Thus, it appears that the less of a tendency an S has to leave items ungrouped on an independent classification task and the greater the tendency he has to form relatively large groups on this task, the more likely he is to recall a relatively large number of words on a noncategorized free-recall test. These results are consistent with the notion that where the groupings are obvious, as in the categorized list, subject determined strategies and methods of organization are not as important or as necessary as in a situation where the groupings are not obvious, as in the noncategorized list and the equivalence range

task. In these types of situations subjects must impose their own strategies and generate their own groupings. Those individuals who are more successful at seeing relationships and forming groups -- thus having fewer individual items to remember -- are more efficient in learning the items presented. The negative relationship evidenced between objects not grouped (compartmentalization) and categorized free-recall is again supportive of the postulate that having fewer individual items to remember is indicative of more efficient learning.

Order of testing and free-recall performance: An unexpected finding with possible implications for future research was uncovered when performance on the free-recall tasks was examined as a function of type of list learned first. That is, there was a difference in performance on the categorized list depending on whether it was learned before or after the noncategorized list. The relevant mean numbers of words recalled on the two types of lists as a function of their presentation order and the sex of the S are presented in Table 3. More words were recalled on the

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Insert Table 3 about here

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categorized list when it was learned after the noncategorized list than when it was the first list the S learned (17.10 vs. 15.45), $F(1,140) = 7.97$, $p < .01$. Performance on the noncategorized list did not depend on the order in which it was learned, $F(1,140) = .42$. While females recalled more words on both the noncategorized and the categorized list, $F(1,140) = 16.73$ and 7.52, p's $< .01$, respectively, the interaction between sex and order was not sig-

nificant for either list, F's < 1.

The value of the correlation coefficient between performance on the categorized and noncategorized lists was .61 when the noncategorized list was presented first and .35 when the categorized list was presented first. The difference between these two values is statistically significant, $t(142) = 2.05$, $p < .05$. However, a closer analysis indicated that this effect existed for females (r's = .74 and .29, $t(67) = 2.52$, $p < .05$) but not for males (r's = .43 and .35, $t(68) = .41$).

A possible explanation of this finding is that the noncategorized list sensitizes the S to the fact that an organizational strategy will facilitate learning. When he then encounters the categorized list where such an organizational strategy can be easily utilized and is evident, he uses it and his performance improves. When the categorized list is learned first, however, it takes some time for the S to discover that such an organizational strategy is appropriate, and hence, this performance is not facilitated to the same extent as when it is administered second. Since the noncategorized list is more difficult to organize and is dependent on subject-generated organizational strategy, the priming effect of recognizing experimenter-determined groupings is not strong enough to facilitate performance. With sufficient practice such facilitation might be possible, but the practice provided by one list is not sufficient. As the present design does not include the appropriate controls to evaluate the reasonableness of this interpretation, further research is suggested.

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TABLE 1

Observed Means and Standard Deviations for All Variables for Males (n=71) and Females (n=73) (N = 144)

Variable	Means			Standard Deviations		
	Male	Female	Combined	Male	Female	Pooled
1. Noncategorized Free Recall	9.30	11.22	10.27	2.87	2.81	2.84
2. Categorized Free Recall	15.44	17.03	16.24	4.04	3.72	3.88
3. Categories Recalled (Categorized List)	5.27	5.56	5.42	.81	.69	.75
4. Words/Category (Categorized List)	2.92	3.07	3.00	.60	.60	.60
5. O - E (Categorized List)	3.47	4.33	3.90	2.43	2.99	2.73
6. ARC (Categorized List)	.41	.47	.44	.33	.33	.33
7. Band-Width	67.75	60.73	64.19	10.73	9.98	10.36
8. Conceptualization (Equiv. Range Task)	12.92	11.88	12.39	4.39	4.38	4.38
9. Compartmentalization (Equiv. Range Task)	7.99	6.88	7.42	7.16	5.72	6.47
10. Range of Group Size (Equiv. Range Task)	6.69	7.36	7.03	5.27	4.76	5.02
11. Average Group Size (Equiv. Range Task)	3.19	3.42	3.31	3.09	2.22	2.68
12. Time[a] (in seconds) (Equiv. Range Task)	593.59	553.85	573.73	167.24	204.77	187.21

[a]Time measure based on N=139, n_{male}=70, n_{female}=69.

TABLE 2

Pooled, Within-group Correlation Matrix for All Variables
(N = 144)

Variable	1	2	3	4	5	6	7	8	9	10	11	12[a]
1. Noncategorized FR Free Recall												
2. Categorized Free Recall	.45											
3. Categories Recalled (Categorized List)	.37	.56										
4. Word/Category (Categorized List)	.29	.83	.01									
5. O - E (Categorized List)	.16	.53	.16	.54								
6. ARC (Categorized List)	.03	.14	.06	.16	.77							
7. Band-Width	.10	.07	-.02	.11	.19	.19						
8. Conceptualization (Equiv. Range Task)	-.08	-.06	-.16	.04	-.05	.03	-.06					
9. Compartmentalization (Equiv. Range Task	-.30	-.23	-.13	-.17	-.06	-.08	-.05	.06				
10. Range of Group Size (Equiv. Range Task)	.13	.11	.16	.03	.08	.05	.11	-.72	-.38			
11. Average Group Size (Equiv. Range Task)	.21	.12	.19	.02	.05	.05	-.03	-.60	-.50	.63		
12. Time[a] (Equiv. Range Task)	-.03	-.11	-.12	-.05	-.01	.06	.03	.32	-.04	-.26	-.12	

For $\alpha = .05$, $r \geq .16$

For $\alpha = .01$, $r \geq .21$

[a]All correlations with the time measure are based on N = 139.

TABLE 3

Observed Means on the Free Recall Tasks by Sex and Order
And by Order Combined Over Sex
(N = 144)

Group	Noncategorized FR Task	Categorized FR Task
Male, Noncategorized List First (n=37)	9.35	16.03
Male, Categorized List First (n=34)	9.23	14.79
Female, Noncategorized List First (n=32)	11.50	18.34
Female, Categorized List First (n=41)	11.00	16.00
Noncategorized List First (n=69)	10.35	17.10
Categcrized List (n=75)	10.20	15.45